



Methane to Markets

The U.S. Government's Methane to Markets Partnership Accomplishments



Fourth Annual Report

October 2009



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For additional information, please visit www.epa.gov/methanetomarkets and www.methanetomarkets.org.

Fourth Annual Report
The U.S. Government's Methane to Markets
Partnership Accomplishments
October 2009



USAID
FROM THE AMERICAN PEOPLE



October 2009

Dear Colleagues,

Collaboration, opportunity, and action. These terms embody the core principles of the Methane to Markets Partnership. Founded in 2004 to reduce global methane emissions, a potent greenhouse gas, Methane to Markets advances the development of projects that recover and use methane as a clean energy source.

The work of the Methane to Markets Partnership has never been more relevant or critical to addressing our shared global climate change, clean energy, and development challenges. While the international community works together to craft long-term solutions for these important global issues, this Partnership is having an impact today. By supporting projects that are reducing methane emissions, Methane to Markets is delivering near-term and lasting climate solutions as well as local environmental, health, and economic development benefits.

As a founding member, along with 13 other countries, the United States has been strongly committed to the success of the Partnership for more than five years. Over this period, through the combined efforts of five federal government agencies, the United States has allocated almost \$40 million to project development and is directly supporting more than 170 projects and activities across the world that are expected to reduce methane emissions by approximately 61 million metric tons of carbon dioxide equivalent annually.

Equally significant, this U.S. contribution has assisted and leveraged similar efforts across the globe. Today, 30 other Methane to Markets Partners are engaged in equally impressive activities supported by the Partnership's more than 900 private sector and nongovernmental organizations in the Project Network. Without the involvement and participation of this Network, the Partnership could not thrive. This report describes the highlights of U.S.-supported projects and activities and documents their contribution to energy security, clean development, and the environment.

As the Chair of the Methane to Markets Steering Committee and as a representative of the U.S. Environmental Protection Agency, I am very proud of our accomplishments in supporting the Partnership. I look forward to a continued U.S. commitment to addressing climate change through the Methane to Markets Partnership and in collaboration with our public and private sector partners.

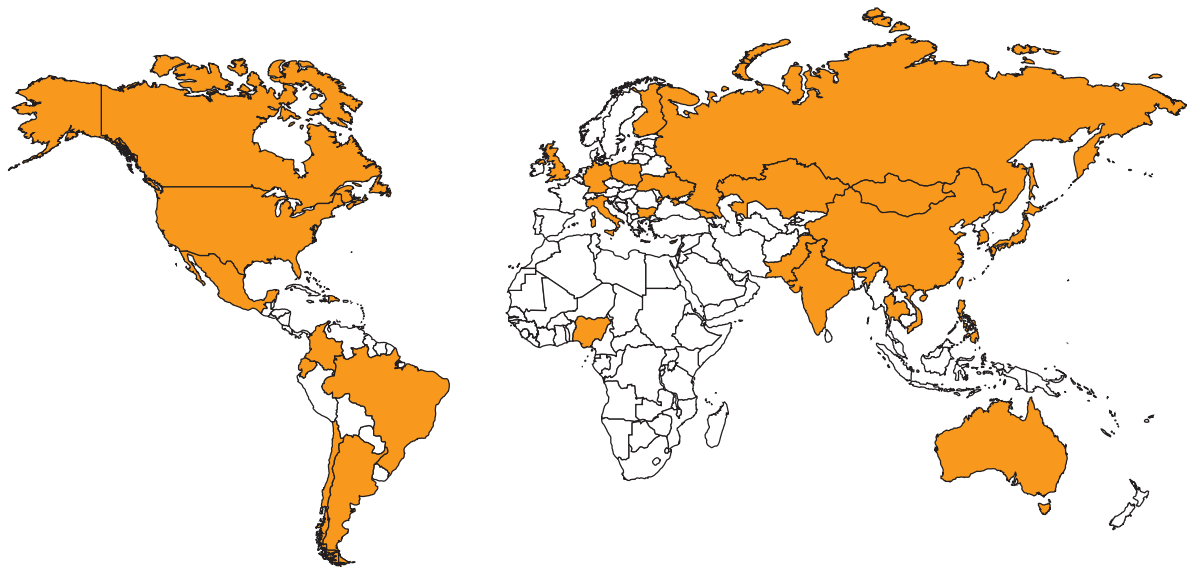
Sincerely,



Gina McCarthy
Assistant Administrator, Office of Air and Radiation
U.S. Environmental Protection Agency
Steering Committee Chair, Methane to Markets Partnership



The Methane to Markets Partnership



- | | | | | | | |
|-----------|--------------------|---------------------|------------|---------------------------------|--------------------------|---------|
| Argentina | Chile | European Commission | Italy | Nigeria | Russia | Vietnam |
| Australia | China | Finland | Japan | Pakistan | Thailand | |
| Brazil | Colombia | Georgia | Kazakhstan | Philippines | Ukraine | |
| Bulgaria | Dominican Republic | Germany | Mexico | Poland | United Kingdom | |
| Canada | Ecuador | India | Mongolia | Republic of Korea (South Korea) | United States of America | |

Methane to Markets Partner Countries account for more than 60 percent of the world's anthropogenic methane emissions.

Climate change is a serious environmental challenge that requires a global response. Methane is a potent greenhouse gas (GHG), second only to carbon dioxide in its contribution to climate change. It is of particular strategic importance given its atmospheric properties and the suite of currently available, cost-effective reduction options (see box on page 5). As such, focusing mitigation efforts on methane can yield near-term climate impacts along with major economic, air quality, and energy benefits.

The United States and 13 other countries formed the Methane to Markets Partnership in 2004. The goal of the Partnership is to help reduce methane emissions quickly and cost-effectively through a collaborative, multilateral framework that unites public and private interests to fight climate change by advancing the recovery and use of methane as a clean energy source. By engaging public and private sector parties, Methane to Markets brings together the technical and market expertise, financing, and technology necessary for methane capture and use project development.

The Partnership focuses on developing projects in four major methane emissions source areas: agriculture, coal mines, landfills, and oil and gas systems. In each of these sectors, cost-effective methane emission reduction technologies and practices are currently available to capture and use the methane gas as a fuel for electricity generation, on-site energy needs, or off-site gas sales. However, despite the availability of proven technologies and the understanding of associated environmental and financial benefits, methane recovery and use projects are not yet the global norm. In many countries, financial, institutional, informational, regulatory, and other barriers have impeded the adoption of methane recovery technologies. Methane to Markets is working to identify and address these barriers in order to combat climate change and deliver clean energy to markets all around the world.

Origins and Structure of the Methane to Markets Partnership

The Methane to Markets Partnership is modeled on the United States' suite of domestic methane emission reduction programs. Since 1993, the U.S. Environmental Protection Agency (EPA) has operated four highly successful public-private partnerships to reduce the market barriers to methane emissions project development in the United States: AgSTAR, the Coalbed Methane Outreach Program (CMOP), the Landfill Methane Outreach Program (LMOP), and Natural Gas STAR. These programs have engaged stakeholders, disseminated information, and catalyzed partnerships to remove barriers to project development and achieve significant on-the-ground results for more than a decade. As of 2007, they have helped to reduce annual U.S. methane

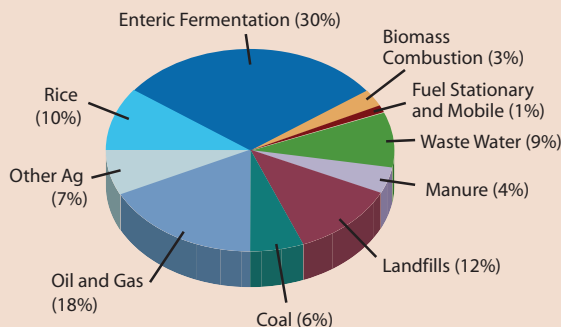
Why Is Methane Important?

Methane is a hydrocarbon and the primary component of natural gas. It is also a potent GHG that is more than 20 times as effective at trapping heat in the atmosphere as carbon dioxide (CO₂). Methane has a much shorter atmospheric lifetime than CO₂ (about 12 years, compared to about 200 years for CO₂).

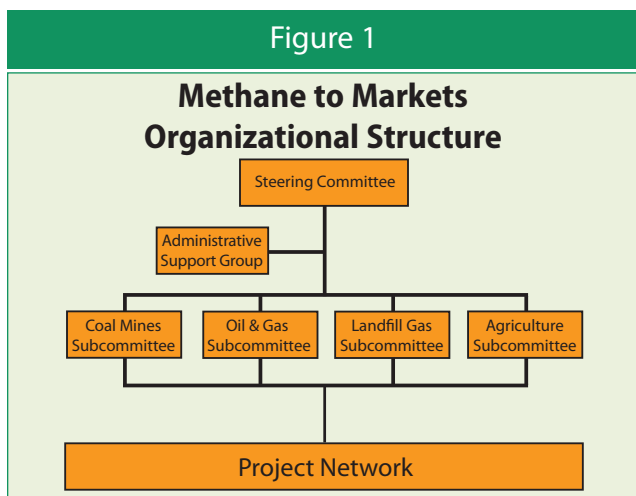
Due to methane's properties, reducing methane emissions can achieve significant near-term climate, energy, human health, and economic benefits. Identifying and capitalizing on cost-effective opportunities to reduce methane emissions lowers the cost of GHG abatement over the long term and allows time for the development of alternative technologies. Also, studies indicate that feasible reductions in methane and other non-CO₂ GHG emissions can help slow climate change over the next 50 years on the same scale as similar reductions in CO₂ emissions. In addition, methane contributes to the growing global background concentration of tropospheric ozone, a GHG and an air pollutant associated with premature mortality. Thus, reducing methane emissions decreases surface ozone everywhere, yielding additional climate benefits as well as improvement in local air quality.

Methane accounts for 16 percent of all GHG emissions globally, with about 60 percent of these emissions coming from anthropogenic (human-related) activities.

Estimated Global Anthropogenic Methane Emissions by Source, 2005



Source: Global Anthropogenic Emissions of Non-CO₂ Greenhouse Gases, 1990-2020 (EPA Report 430-R-06-003)



emissions from the target source to 14 percent below 1990 levels. The desire to share the success of these program models along with the clear opportunity to implement methane projects globally was a major force behind the formation of the Methane to Markets Partnership.

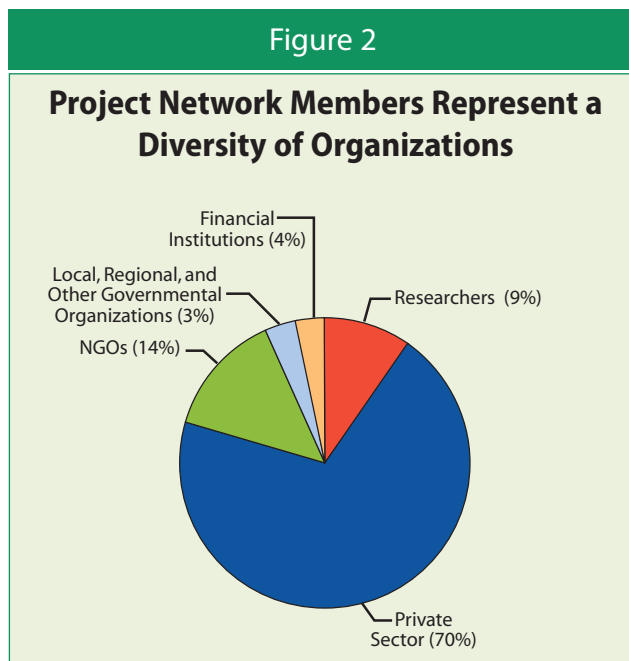
Using a similar approach to the U.S. domestic methane programs, Methane to Markets brings together industry, nongovernmental organizations (NGOs), national governments, and other stakeholders to advance project development around the world. The Partnership is structured around the Steering Committee, the Administrative Support Group (ASG), or secretariat, four subcommittees, and the Project Network (see Figure 1). The Steering Committee guides the work of the Partnership and is supported by the ASG, which is currently housed at EPA. The subcommittees (Agriculture, Coal Mines, Landfills, and Oil and Gas Systems) are responsible for the technical work in each of the Partnership’s target sectors. Each subcommittee operates as a partnership of government representatives and Project Network members.

The Project Network: Bringing Expertise to International Project Development

The Project Network is an engaged community of industry, nonprofit organizations, international financial institutions, and other stakeholders who actively participate in meetings

and activities as a means of building capacity, transferring technology, and promoting private investment. It plays a vital role in the financing, development, and operation of methane capture and use projects.

The Methane to Markets Partnership established the Project Network to ensure that national governments pursuing methane emission reductions would be able to leverage the project development knowledge, experience, and resources of these critical stakeholders around the world. Today more than 900 organizations from countries in Africa, Asia, Australia, Europe, North America, and South America participate in the Project Network. These diverse organizations (see Figure 2) identify and implement cost-effective methane recovery and use projects globally; address the informational, technical, and institutional barriers to project development; and contribute to capacity building and technology transfer activities. At the same time, these organizations can increase profits, expand their businesses, distinguish themselves in the marketplace, and more successfully achieve their strategic goals—all while helping to address the critical issue of climate change.



Active participation by Project Network members is critical to the success of the Partnership, and facilitating Project Network member involvement is a top priority for the Partnership. Methane to Markets invites and encourages Project Network members to participate in as many of the Partnership-sponsored meetings, events, and activities as possible.

Dismantling Barriers and Advancing Project Development

Despite Methane to Markets’ many successes, many barriers to advancing methane recovery and use projects around world remain (see Table 1). Methane to Markets Partners and Project Network members are committed to addressing and overcoming these obstacles

Table 1. Barriers to Project Development

Targeted Barriers to Project Development for Each Subcommittee*	Agriculture	Coal Mines	Landfills	Oil and Gas Systems
Lack of financing and/or understanding of how to apply for funding or investment from multilateral organizations or other financial institutions	X	X	X	X
Insufficient in-country knowledge and/or experience developing methane recovery and use projects (i.e., national capacity)	X		X	
Lack of understanding about the legal, regulatory, economic, and policy frameworks in various countries (e.g., gas ownership rights, taxes, or incentives)	X	X		X
Lack of country-specific information on the current status of methane recovery and use activities (e.g., market assessments) as well as needs, opportunities, and priorities (e.g., sector profiles)	X	X	X	X
Insufficient identification of suitable candidate sites/facilities for potential methane recovery and use project assessment and development	X		X	
Lack of available/appropriate technology (e.g., best practices) and/or technical knowledge/expertise	X	X	X	X
Lack of demonstrated technical or economic feasibility of technologies and/or projects (e.g., feasibility studies, demonstration projects)		X	X	
Difficulty accessing existing documents, tools, and other resources characterizing methane recovery and use			X	

** While additional barriers across all sectors might exist, these barriers were self-selected and prioritized by the subcommittees’ members.*

through training and capacity building, technology demonstration, market development, the development and dissemination of tools and resources, and direct project development support.

One central tactic Methane to Markets employs to address obstacles is to support subcommittees and Partner Countries in their creation of action plans and country-specific strategic plans, respectively, to guide activities and projects. These plans include:

- Overview of methane recovery and use opportunities.
- Descriptions of technologies and best practices.
- Key barriers/issues to project development.
- Possible cooperative activities to dismantle barriers and increase methane recovery and use.
- Strategies to engage Project Network members.

In addition, the Partnership reduces informational barriers to project development through the Methane to Markets Partnership's conferences and events, online tools, and Web site.

Methane to Markets 2.0

The Methane to Markets Web site has always served as the primary portal for distributing key Partnership tools and information as well as a mechanism to announce upcoming events and distribute Partnership news highlights. In 2009, the Methane to Markets Partnership unveiled a new Web site. It features enhanced content and navigation to facilitate the use of the Partnership's tools and resources.

For example, the new Web site hosts improved country-specific pages that serve as portals to the information most relevant to that particular country. A new "translate this page" function delivers content into dozens of languages to support the Partnership's non-English-speaking community. The new Web site also includes features that enable users to track news by category and receive stories as they are posted on the Web. Users can also share their own Methane to Markets-related news and activities with others through the Web site. New content has been added such as success stories, project links, and links to resources for each subcommittee and country page to make information easier to access.

Online Tools Make Project and Country Data Easily Accessible

Methane to Markets has developed a wide array of tools that provide accurate and targeted information to catalyze project development. All of these tools provide critical data and information on project opportunities and technologies and are accessible through the Partnership's newly enhanced Web site.

- **Project Tracking Database.** This database connects stakeholders to more than 130 ongoing and 40 proposed projects. For each project, the database contains a project description, anticipated benefits and outcomes, estimated annual GHG emission reductions, and primary contacts.
- **International Landfill Database.** With key data on more than 480 landfills around the world, this database helps developers assess and pursue landfill gas-to-energy project opportunities.

- **International Coal Mine Methane Projects Database.** This database contains information on more than 230 coal mine methane (CMM) recovery and utilization projects that are operating, in development, or planned in 13 countries.
- **Coal Mine Methane Technology Database.** Compiled by Australia's Department of Tourism, Industry, and Resources, this database provides information, contacts, and case studies for a range of CMM recovery and utilization technologies.
- **ON TIME (Online Tool for Identifying Methane Emissions).** The government of Canada developed this online tool to give policymakers, project developers, financiers, and other important stakeholders easy-to-access, credible information on cost-effective technologies and practices that reduce methane emissions in the oil and gas sector.

Visit the redesigned Methane to Markets Web site at www.methanetomarkets.org.

Partnership Efforts Are Yielding Results

Since its beginning in 2004, the Partnership has grown substantially in size, scope, and influence and is already yielding tangible results. Highlights of these accomplishments, which stem from U.S. support of the Partnership, include:

- **Supported the development of more than 170 methane emission reduction projects** in 16 Methane to Markets Partner Countries around the world. These projects are already delivering reductions of 26.7 million metric tons of carbon dioxide equivalent (MMT_{CO₂E}) per year and, when fully implemented, will yield approximately 61 MMT_{CO₂E} annually (see Figure 3).
- **Recruited more than 900 Project Network members** from around the world, including some of the most well-respected financial institutions, consultants, manufacturers, project developers, and NGOs in the industry.
- **Expanded from 14 initial Partners to 31**, with Bulgaria, Chile, the Dominican Republic, and Georgia being the most recent additions in 2009. Together, these Partners are responsible for more than 60 percent of the world's anthropogenic methane emissions.
- **Held 20 events in 12 countries**, bringing together methane professionals from a broad range of technical disciplines, countries, and sector interests.
- **Established an international forum solely focused on methane—the Methane to Markets Partnership Expo.** The first Partnership Expo, held in Beijing, China, in 2007, brought together more than 700 members of the international methane community and showcased more than 90 potential methane capture and use projects

from around the world. Because of its success, Methane to Markets is planning to hold a second Partnership Expo in 2010 in India.

- **Developed and refined the Partnership's suite of online tools and resources** that facilitate cross-disciplinary communication and international project development (see description of online tools on page 8).

The United States estimates that within 10 years, the Partnership has the potential to deliver estimated annual reductions in methane emissions of more than 180 MMT_{CO₂E}. This is the equivalent of recovering more than 760 billion cubic feet of natural gas, the annual emissions from 50 million cars, or the annual emissions from 76 500-megawatt (MW) coal-fired power plants. If achieved, these reductions could lead to stabilized or even declining levels of global atmospheric concentrations of methane.



Projects displayed at the Partnership Expo in 2007 in Beijing, China.

U.S. Government Leadership in Reducing Methane Emissions

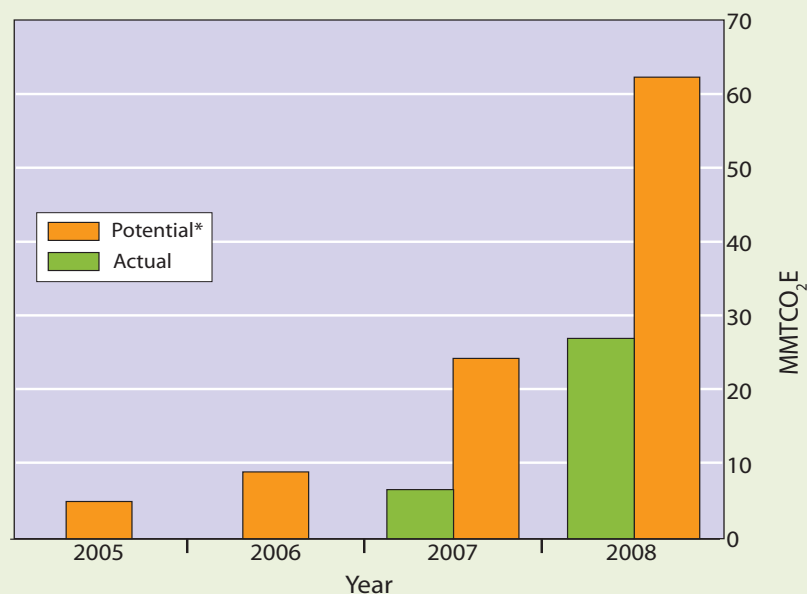
The United States has been a strong supporter of Methane to Markets since the beginning of the Partnership, and it continued its support in 2008. In 2004, the United States pledged up to \$53 million over a five-year period to facilitate the development and implementation of methane projects in developing countries and countries with economies in transition. As this funding has been committed, it is supporting a broad range of efforts through the Partnership, such as training and capacity building, market development, feasibility assessments, and technology demonstrations.

United States Awards Grants for International Methane Projects

In 2009, EPA awarded more than \$4 million in competitive grant funding to applicants proposing methane reduction projects in Methane to Markets Partner Countries. This was the third EPA Methane to Markets grant solicitation. As with previous solicitations, it was highly competitive. Nearly 100 proposals were submitted for work in 19 different countries. EPA anticipates awarding funding for 28 cooperative agreements for methane capture and use work in 13 Partner Countries. In 2008, EPA awarded more than \$4.5 million in grant funding to projects in 12 Partner Countries and all four sectors.

Figure 3

Annual Reduction of Methane Emissions From U.S.-Supported Projects, 2005–2008



* Potential emissions reductions include actual reductions from U.S.-supported projects now online.

A Multi-Agency Effort

U.S. government efforts under the Methane to Markets Partnership are led by EPA and involve the collective efforts of the following major agencies and departments of the federal government:



EPA is the lead U.S. agency and, as host of the Administrative Support Group, coordinates and administers Partnership activities both domestically and internationally. EPA builds on the success of its voluntary methane reduction programs, which have been instrumental in reducing U.S. methane emissions in 2007 by more than 14 percent below 1990 levels.



U.S. Department of Energy contributes expertise in natural gas and CMM technologies.



U.S. Department of State leads international climate change policies and activities and supports the development of methane projects.



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U.S. Agency for International Development (USAID) provides technical expertise in the economic reform of energy sectors to create markets that support private sector projects in developing countries and those with economies in transition.



U.S. Trade and Development Agency (USTDA) facilitates development in emerging markets by promoting U.S. partnerships in high-priority overseas projects.



U.S. Department of Agriculture lends technical expertise in the animal waste management sector.

Figure 4

FY 2008 U.S. Expenditures by Type of Activity

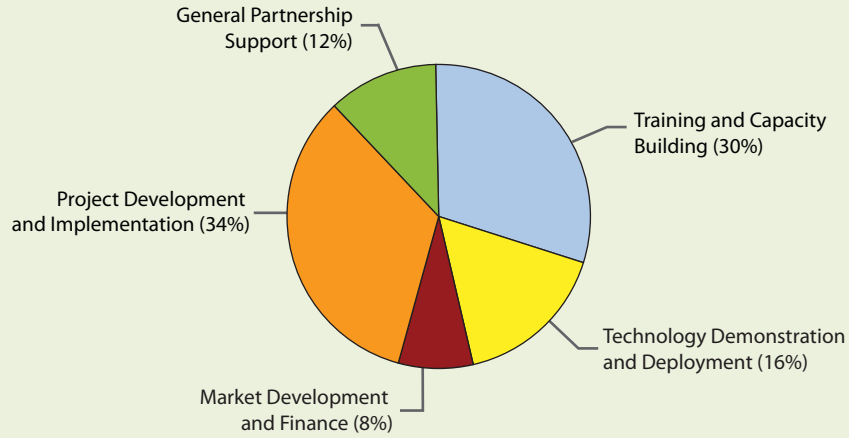
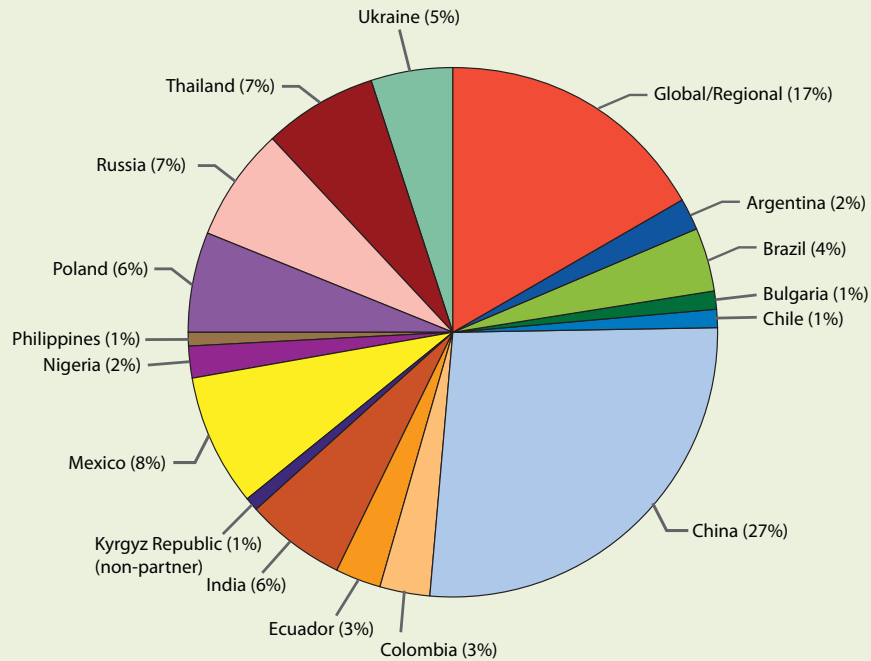


Figure 5

FY 2008 U.S. Expenditures by Recipient Country



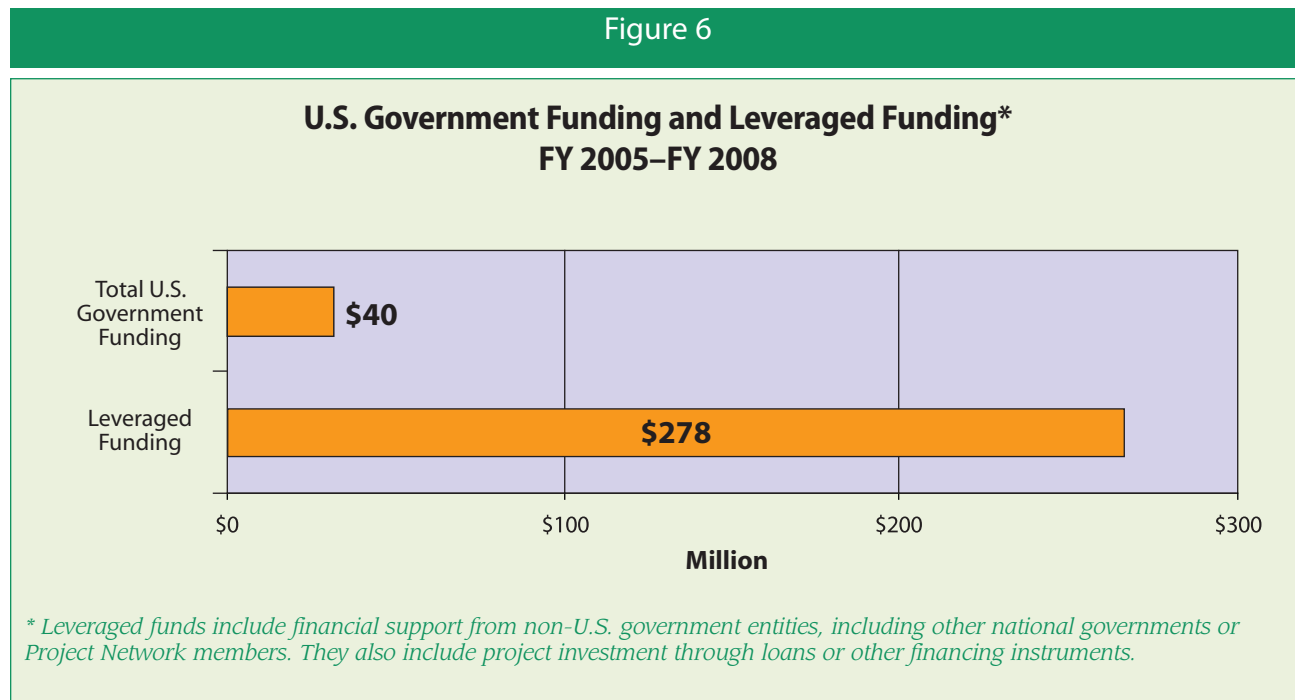
Leveraging the efforts of fellow Partner Countries along with the expertise and investment of the United States and the international private sector is central to the U.S. commitment.

U.S. government contributions were critical in making 2008 another successful year. U.S. government funding for the Partnership in fiscal year (FY) 2008 was \$10.4 million, bringing the total U.S. financial commitment to the Partnership since its inception to approximately \$40 million. These resources continued supporting pre-feasibility and feasibility studies at potential project sites, while addressing market, institutional, and other barriers to project development and building capacity through technology transfer and training (see Figure 4). The United States expends these resources across more than a dozen Partner Countries and regions (see Figure 5) and successfully

leverages funding from other sources (see Figure 6). These efforts are directly leading to the development of full-scale projects in many Partner Countries. When fully implemented, these projects will deliver estimated annual emission reductions of more than approximately 61 MMTCO₂E.

EPA also maintains www.epa.gov/methanetomarkets, which details contributions and responsibilities of the six major federal agencies involved in the Partnership. The Web site also features basic information on methane capture and use, related EPA voluntary programs, and links to Partnership newsletters and press releases.

The following sector-specific updates provide a brief overview of some of the most notable U.S. government-sponsored activities in the Partnership's four sectors that were funded in 2008.





Agriculture (Manure Management)

Globally, agricultural sources of methane emissions include enteric fermentation, rice planting, and livestock manure.

Methane to Markets' agricultural activities focus on emissions from livestock manure, although the Partnership is exploring opportunities to expand to other methane sources. Methane produced and emitted during the anaerobic decomposition of livestock manure can be reduced, captured, and used as clean energy with anaerobic digestion technology. In 2005, the total amount of global methane from livestock manure that could potentially be utilized in this manner was estimated to be slightly more than 230 MMTCO₂E. Through Methane to Markets, the United States spent more than \$1.9 million in 2008 advancing the recovery and use of methane at agricultural operations. Highlights of these activities are presented below.

Support for Livestock and Agro-Industrial Wastes

To stimulate the market for methane capture and use, EPA is conducting anaerobic digester feasibility assessments and technology demonstration projects in 11 countries in Southeast Asia, Latin America, and Eastern Europe. As a first step, EPA and in-country partners are identifying the resource potential for livestock manure and agro-industrial wastes by evaluating the methane reduction potential for specific sub-sectors (e.g., wineries, slaughterhouses, rice processing, dairy, fruit processing). The team is focusing on the sub-sectors with the greatest opportunities for cost-effective implementation of anaerobic digesters with methane recovery. As part of this effort, Methane to Markets developed a methodology for determining the feasibility of anaerobic digester systems at individual facilities,

Reducing Methane Emissions in Vietnam

In Vietnam, swine farmers are recovering methane through household, farm, multiple-family, and communal demonstration systems. Many of these projects use recovered gas for cooking fuel, reducing the harmful health impacts of cooking with wood fuels by improving air quality in enclosed kitchen spaces. For example, in northern Vietnam's Tu Duong village, communal project participants collect pig wastes from 100 family-owned backyard piggeries. The waste is transferred through a gravity-based village canal system to a series of anaerobic digesters. The gas is piped back to the families and used as cooking and lighting fuel. The fee charged for the gas pays for system maintenance and a full-time operator.



An anaerobic digester in northern Vietnam's Tu Duong village helps provide fuel for the kitchen.

taking into account the size of the operation, waste management systems currently in place, potential for co-digestion of manure with agro-industrial wastes, and climate.

To date, resource assessments have been completed in Argentina and the Philippines and are underway for India, Mexico, Thailand, and Vietnam. During the project's next phase,

feasibility studies will be conducted at five facilities that will provide models for replication at other locations. As part of this effort, a feasibility study is being prepared for a covered lagoon for slaughterhouse wastes in Colombia, which (once completed) could provide the basis for replicating the covered lagoon design for other slaughterhouses in the country. In the final phase, the project will support construction, startup, operator training, and performance monitoring for systems at eight locations.

Improving Livestock Waste Management in Southeast Asia

Since 2004, EPA and the World Bank have supported improved livestock waste management projects in Southeast Asia. The World Bank has provided \$21 million to China, Thailand, and Vietnam to develop affordable methods to help control pollution at livestock waste management facilities. As part of this program, EPA has provided financial support for demonstration projects, reviewed all technical aspects of livestock waste management programs, and begun developing sustainable policies to foster the replicating of and support for pollution control technologies, such as anaerobic digesters, over the long term. Individual countries are sharing their approaches to technical demonstrations, measuring impacts, and developing regional support infrastructure. Through the deployment of anaerobic digestion technologies and land application of waste to crops, these initiatives are mitigating water pollution from confined swine production while achieving other environmental and human health benefits. To date, six projects are in operation in China, three in Vietnam, and one in Thailand. A number of other projects are currently in the planning or construction phases.

Livestock Waste Management and Emissions Reductions in China

Dengdaming Pig Farm is a project demonstration site located in Changning Township in Guangdong Province, a major livestock production region in China approximately 90 kilometers

from the provincial capital of Guangzhou. This farrow-to-finish swine farm has a standing pig population of 3,000, a typical number for swine farms in this region. An up-flow anaerobic digester with a separate floating type gas storage recovers gas to power a 60-kilowatt engine generator and produces electricity for 12 hours a day. The Chinese are also starting to demonstrate digesters that combine gas production with gas storage in factory fabricated steel tanks. These technical elements reduce costs and are critical in China's replication strategy.



Anaerobic digester at Dengdaming Farm in Changning Township, China.

International Protocol for Anaerobic Digestion

EPA is developing an international protocol to evaluate the environmental performance of anaerobic digestion systems. Currently, comparison of various anaerobic digestion technologies is difficult because system data have not been collected following a standardized methodology. The ability to compare different system design approaches with respect to biogas production, waste stabilization, and cost effectiveness on a uniform basis has been lacking. The purpose of this protocol is to provide a standardized method to evaluate different anaerobic digestion technologies and allow for comparison of the technologies. EPA assembled a panel of international experts on anaerobic digestion to review the protocol in order to assure its applicability to systems used in different regions around the world. The final protocol was completed in September 2009.



Coal Mines

Methane gas released from coal mining activities can be captured and used as a clean energy source, resulting in reduced GHG emissions, improved air quality, and enhanced mine safety. In 2005, global methane emissions from coal mines were estimated to be nearly 400 MMTCO₂E. The United States is a leader in CMM recovery and continues to work with international partners through Methane to Markets to share information, expertise, and technology to promote CMM project development. In this reporting year, the U.S. government has supported these initiatives with more than \$2.2 million in funding. Major activities from this sector are summarized below.

Supporting Technology Demonstration Projects in China and Poland

EPA is supporting demonstration projects to showcase cutting-edge technologies to recover and use CMM. In Poland, EPA is sponsoring a project to study and demonstrate a technology



A small-scale LNG plant converts CMM into LNG at the Zory Coal Mine in Poland.

that converts CMM to liquefied natural gas (LNG). In China, EPA is supporting a project to evaluate and demonstrate the use of diluted methane emissions from underground mine ventilation systems (also known as ventilation air methane or VAM) using a new technology, a monolithic catalytic combustor, at a Chinese coal mine.

Building Capacity and Overcoming Informational Barriers in India and China

One significant barrier to developing effective CMM recovery and use projects is the lack of information about specific coal mine project opportunities and available technologies and practices. To help project developers overcome these barriers, the United States is supporting several initiatives to increase the flow of information and foster in-country technical expertise.

In India, which is currently the world's third-largest coal producer, EPA, USTDA, and the government of India established a CMM/Coalbed Methane (CBM) Clearinghouse. India's Ministry of Coal and the Ministry of Petroleum and Natural Gas manage the clearinghouse. In 2008, EPA and USTDA organized a kickoff event to inaugurate this work in Ranchi, India, and EPA has continued to provide technical training and funding. India's coal production is predicted to increase dramatically in the near future, and CMM emissions are expected to increase as well unless methane recovery and utilization projects are implemented.

In China, EPA continued to support the work of the CBM Clearinghouse in Beijing. The clearinghouse provides services to a variety of international organizations, including the International Energy Agency (IEA), the Asian Development Bank, and the United Nations Development Program. It also provides project developers and investors with easily accessible, in-country technical and regulatory expertise on CMM project development.

In 2008, the United States also supported a number of capacity building initiatives in China. For instance, USTDA and EPA sponsored an in-depth training program for the China National Development and Reform Commission in Dalian, China. With technical assistance from EPA, the training focused on technical aspects of CMM projects, including degasification, recovery, and end-use technologies.

EPA also supported several initiatives to increase awareness and expertise at the provincial level in China. For example, EPA funded the CMM Recovery and Utilization Initiative in Guizhou Province, a relatively poor province with more than 2,000 coal mines producing a total of 100 million tons of coal annually. This province has great potential for CMM recovery and utilization as a clean energy source, but for most mines it is not realized due to lack of information, communication, and market barriers. The initiative provided international project developers with focused and current information regarding project development opportunities at 45 coal mines in Guizhou and included a successful workshop to connect stakeholders with the international project development community.

EPA also supported IEA's efforts to evaluate the potential for CMM projects in the Guizhou

Chinese Mines to Use Advanced Technology to Deliver CMM-based Power

A recent EPA-sponsored feasibility study is helping operators at six mines in the Chongqing Municipality of China to purify and liquefy medium-concentration CMM into LNG. Implementing the latest technology for CMM, officials from the Songzao Coal Mine plan to integrate CMM-based power beyond the immediate vicinity of the mines and into the country's larger energy economy—a technological milestone for China.

The project sponsor, Chongqing Energy Investment Group, is pursuing funding while waiting for final government approvals. Construction is expected to begin in 2010 allowing operations to start in 2012. When completed, the Songzao Coal Mines are expected to generate 170 million cubic meters of LNG to be sold into China's booming natural gas market. Additionally, new on-site mine-mouth power generation facilities, with a capacity of 26.9 MW, will use a portion of the CMM pumped from the most remote stations as fuel. Total emission reductions are expected to reach 44.1 MMTCO₂E over the 15-year life of the project.

and Sichuan provinces, two relatively overlooked provinces in terms of CMM development. Based on extensive field visits and interviews, IEA developed a white paper that outlines recommendations for reducing technology, policy, and financial barriers. In addition, EPA funded a project organized by the Jackson Hole Center for Global Affairs that focused on the challenges and opportunities in the southern part of Shanxi Province, China's largest coal-producing province. This effort brought together key stakeholders at a workshop in Jincheng to address the barriers to CMM project development in this important coal region.

Supporting Pre-Feasibility and Feasibility Studies in Partner Countries

Pre-feasibility and feasibility studies are key steps in project development. Pre-feasibility studies help developers determine whether a project has the potential to succeed financially and technically. This information is necessary to raise needed capital and generate interest to move the project forward to the next stage of development: the feasibility study. The feasibility study provides developers with more detailed analysis on costs, challenges, and expected results based on project parameters. Undertaking either type of study can be challenging and expensive.

The United States has funded several pre-feasibility and feasibility studies for projects in the coal sector to help advance project development in China, India, Poland, and Mongolia. These studies provide important information that accelerates project implementation. For example, in 2008:

- EPA conducted three comprehensive feasibility studies at Chinese coal mines to assess the technical and economic viability of implementing CMM recovery and utilization projects:
 - Liuzhuang Mine in Anhui Province.
 - A group of six mines in the Songzao Coal Basin in Chongqing.
 - A group of six mines at Hebi in Henan Province.
- The study for the Songzao mines evaluated CMM use for a combined power generation/LNG project and estimated the potential to reduce emissions by 4.4 MMTCO₂E annually.

- In India, EPA funded a study quantifying VAM from two mines in the Jharia Coal Basin. EPA is also funding a feasibility study of CMM recovery from underground coal mines in three coal basins: Bokaro, Jharia, and the Ranigani Coal Fields.
- In Poland, EPA funded an assessment of VAM at 10 mines to determine their feasibility for methane mitigation or energy recovery projects.
- In Mongolia, EPA funded a pre-feasibility study to evaluate the potential for CMM recovery and utilization at the Nalaikh Coal Mine.



Dr. M. Badarch, General Director of the Mongolia Nature and Environment Consortium and member of the Methane to Markets Coal Subcommittee, visits the Nalaikh Coal Mine near Ulaanbaatar, Mongolia.

Overcoming Financial and Policy Barriers in Russia and Eastern Europe

The United States has supported a multi-year effort by the United Nations Economic Commission for Europe (UNECE) to reduce financial barriers to CMM projects in Russia and Eastern Europe. In 2008, this project con-

cluded as technical and financial experts helped develop bankable documents for the Krasnogorskaya Mine in Russia. This mine was then showcased before six interested investors in London. The final report has been posted on the UNECE Web site to share lessons learned.



Landfills

Methane is produced from landfills when organic matter decays under natural anaerobic conditions.

Landfill gas (LFG) can be a source of clean energy, typically composed of about 50 percent methane. LFG can be used as a direct substitute for fossil fuel consumption to generate electricity, or refined and injected into the natural gas pipeline. Capturing and using LFG in these ways can yield substantial energy, economic, environmental, air quality, and public health benefits.

In 2005, global methane emissions from landfills were estimated to be nearly 750 MMTCO₂E. This year, the United States has been a leader in the recovery of LFG and has spent more than \$3.2 million to expand the productive use of LFG through Methane to Markets. Highlights of these efforts are summarized below.

Building Capacity Through Workshops and Training in Colombia, Ecuador, and Nigeria

At the International Renewable Energy Conference Africa, held annually in the Nigerian capital city, Abuja, EPA shared international developments in the LFG-to-energy sector and brought organizations together to stimulate project development at Nigeria's landfills. More than 100 people from Nigerian state and federal government agencies, the private sector, and academia attended as well as several participants from other African and European countries. The Nigerian landfill sector is now seeing a burst of activity. Developers are preparing a preliminary inventory of landfills,

planning to evaluate the feasibility of LFG energy at landfills, and working with other stakeholders in Nigeria's waste management sector, including the Waste Management Society of Nigeria, to identify opportunities.

In Colombia, as part of a national conference organized by the Colombian Association of Environmental and Sanitation Engineering, EPA held a workshop and training session on the basics of LFG capture, estimating gas recovery potential, and energy utilization technologies. Approximately 100 participants attended, including landfill and solid waste officials representing several Colombian municipalities.

In July 2008, EPA helped train approximately 150 representatives of Ecuadoran municipalities, including several mayors, in LFG energy project development. The workshop was interactive, allowing participants to share lessons learned and best practices.

Pre-Feasibility and Assessment Studies Conducted in Argentina, India, Mexico, and Ukraine

Thorough study and analysis are essential for launching successful LFG projects. Using a range of energy recovery technologies, engineers conduct pre-feasibility and assessment studies to generate important data, such as the availability of LFG, and determine the economic feasibility of a specific project. These data are vital in helping developers and investors decide if they want to take the project to full development.

- In Bahia Blanca, Argentina, a seaport city in the southeast portion of Buenos Aires Province with a population of approximately 300,000, EPA conducted a pump test for an LFG pre-feasibility study. EPA estimated that projected gas recovery potential in 2008, after installation of a gas collection system, was approximately 625 cubic meters per hour. EPA completed and presented the report to municipal officials in June 2008. A potential end-user has been identified and EPA continues to work with the municipality to advance this project.
- In Ahmedabad, India, EPA conducted a direct user assessment of five local industries around the Pirana Landfill. The local industries included a compost factory, cement factory, denim factory, dyeing facility, and a chemical facility. EPA collected information on the energy needs of these facilities as well as their distance from the landfill. EPA also conducted a feasibility study to determine whether LFG could be used as a source of LNG for vehicles in India. The final report will be released in late 2009.
- In Mexico City, EPA conducted a preliminary assessment of the potential for LFG recovery and utilization at the Bordo Poniente Landfill. With a capacity to hold 56 million tons of solid waste, the landfill is Mexico's largest and serves the 20 million residents of Mexico City. The Mexico City municipal government asked EPA to conduct this assessment to enable it to have an objective third-party evaluation with which to compare LFG studies that it and other organizations have completed. The assessment found that Bordo Poniente is a good candidate for an LFG recovery and utilization project. It would have the potential to reduce approximately 5.15 MMTCO₂E through 2012 and produce 14 MW of electricity at full capacity.
- In Mariupol, Ukraine, near the Sea of Azov, EPA conducted pump tests at a local landfill. Three vertical extraction wells, seven monitoring probes, collection piping, and an electric blower provided by an adjoining brick manufacturing facility were installed, and local Ukrainian engineers conducted the drilling. Based on the initial results, EPA estimated LFG recovery to be 290 to 408 standard cubic feet per minute, a robust estimate considering most landfills in the country are controlled but uncapped and uncovered. After finalizing the pump test, EPA examined various end users for the gas, including a flaring only option as well as direct use by the brick manufacturing facility. EPA will use data from this pump test, as well as a 2007 pump test conducted in Chernvtsi, to develop a Ukraine-specific LFG recovery model in 2009.



Constructing a test well for a pump test at the Bahia Blanca landfill in Argentina.

Landfill Data Collection Efforts in Argentina, Russia, Thailand, and the Philippines

EPA collaborated with Partner Countries in the collection of landfill data to explore the capture and use of LFG.

- In Argentina, working with the Asociación para el Estudio de los Residuos Sólidos (ARS) and Universidad Nacional del Centro de la Provincia de Buenos Aires, Olivarría (UNCPBA), EPA has launched efforts to collect landfill profile data on mid-size municipal landfills and controlled dumps (serving populations greater than 100,000) and to evaluate potential direct-use opportunities, respectively. To date, ARS has identified 40 landfills and is continuing efforts to collect additional profile data. Additionally, UNCPBA has evaluated 10 sites that are currently collecting gas but not using it for energy. Of those sites, two appear to have the potential for a direct-use project. EPA will be exploring direct-use opportunities at these sites in the future.
- In Novokuznetsk, in southern Siberia, EPA assessed candidate sites and assisted a local nonprofit organization, the Ecological Research Centre (ERC), with the first comprehensive landfill inventory in Russia. With funding from an EPA grant, ERC has collected data from more than 800 landfills representing 72 out of Russia's 83 regions. The data include critical information on landfill location, size, capacity, waste depth, and open and closure years. ERC completed the database and presented the results at Russia's biannual Waste-Tech Conference in Moscow in 2009.
- With EPA participation, the governments of Thailand and the Philippines took part in a scoping mission to gather data and information on their landfills. As part of this effort,

EPA Assessment Advances Recovery Options at Colombian Landfill

The Doña Juana Landfill, located in and owned by the city of Bogotá, Colombia, will soon be a source of clean, domestic energy. Thanks in part to a 2007 EPA grant, engineers were able to assess the landfill and find significant potential for methane capture and use. This led to the site being featured at the 2007 Partnership Expo in Beijing, China. Since then, landfill operators have installed a flaring system that began operating in early 2009, and they continue to research full methane generation potential and consider future options. While site conditions and leachate collection system limitations prevent recovery of all biogas at the site, EPA estimates the landfill could realize annual emissions reductions of more than 1.2 MMTCO₂E by 2016 when the landfill is anticipated to close with more than 48 million tons of waste in place.



Doña Juana Landfill in Bogotá, Colombia.

EPA met with LFG energy stakeholders and visited landfills to obtain additional site-specific landfill data.

Model Developed for Chinese LFG

EPA completed the first draft of the Landfill Gas Emissions Model (LandGEM) simulating waste and climate conditions in China. This model will allow users to produce typical LFG generation and recovery estimates for landfills located in various regions of China. EPA is anticipating a full launch of the model to take place in late 2009.



Oil and Gas Systems

Methane emissions from oil and gas systems can be the result of normal operations, routine maintenance, and system disruptions. Reducing fugitive emissions can minimize product losses, enhance energy security, lower methane emissions, and increase revenues. In 2005, global methane emissions from oil and gas systems that could be utilized were estimated at nearly 1,170 MMTCO₂E.

The United States has collaborated with the Methane to Markets Partnership to encourage Partner Countries to implement proven, cost-effective technologies and practices that improve operational efficiency and reduce emissions. In this reporting year, the U.S. government has spent more than \$2.3 million to support the deployment of these measures. Some of the U.S. government's notable 2008 accomplishments and ongoing activities are discussed below.

USAID and EPA Continue to Assist in PEMEX Efforts to Reduce Methane Emissions

USAID and EPA are continuing their support of several project activities with Mexico's state-owned oil company, Petróleos Mexicanos (PEMEX). The overall aim is to achieve significant cost-effective reductions in methane emissions at PEMEX and implement a sustainable GHG management program. The key benefits will include increased projects, improved energy efficiency, conservation of a valuable non-renewable resource, and reduced emissions. Ongoing activities focus on identifying and developing methane emission reduction projects and building organizational resources to sustain this work. To date, PEMEX has conducted campaigns at six facilities to quantify methane emissions, identify emissions reduction opportunities, and provide on-the-job training.

Through directed inspection, maintenance, and replacement of wet seals on compressors, PEMEX has reduced on-site emissions by approximately 30,000 metric tons of CO₂ equivalent (MTCO₂E). PEMEX has additional compressor seal replacement projects underway, which will reduce emissions by an additional 70,000 MTCO₂E. Projects that could yield additional reductions of approximately 400,000 MTCO₂E in four other facilities have been identified.

EPA is helping PEMEX management establish internal leadership and organization to sustain further methane emissions reduction activities. As part of this effort, PEMEX is developing a comprehensive, corporate-wide emissions inventory. The inventory will serve as the basis for determining abatement potential. Specifically, in parallel, EPA has developed a marginal abatement cost (MAC) model tailored to the specific attributes of PEMEX. The MAC model is intended to provide information and guidance to PEMEX leadership as it advances its climate change strategy and sets methane emission reduction targets.

Work Continues on Reducing Emissions From Oil and Natural Gas Assets in India

In 2008, through Natural Gas STAR International, EPA continued its partnership with India's Oil and Natural Gas Company (ONGC) to work on reducing methane emissions. ONGC provided detailed operational data on seven of its sites, and EPA performed analysis to determine four priority sites. EPA analyzed and aggregated the emissions measurement results as well as the economic features for 12 methane recovery projects at these sites. If fully implemented, these projects could save approximately 154,000 MTCO₂E.

Methane to Markets–ONGC Collaboration Builds Capacity for Methane Reductions

The technical collaboration between EPA and the Oil and Natural Gas Corporation of India (ONGC), administered under the Methane to Markets Partnership, is building a strong base of knowledge and capacity within ONGC to cost-effectively reduce methane emissions now and into the future. Based on methane emissions identified and quantified during collaborative measurement studies in May 2008, and a resulting directive from the Board of Directors to actively implement mitigation projects, ONGC has reduced methane by approximately 115.47 thousand cubic feet, which is approximately 46,700 MTCO₂E. ONGC achieved these reductions through a variety of means, including repairing pipeline leaks, changing valves and replacing valve packings, replacing rod packing seals in reciprocating compressors, and at times simply tightening bolts. Thanks to these simple maintenance activities, ONGC is reaping the benefits of saving natural gas valued at \$134,116 (at local natural gas values), increasing operational efficiency, and enhancing workplace safety by reducing fire hazard.

And this is just the start. ONGC has formed an internal measurement team and is currently procuring methane emission detection and measurement equipment in order to be able to replicate measurement studies in the future. EPA and ONGC have collaborated to train this team on the use of the measurement study equipment and conducted detailed technical studies to support implementation plans for more extensive capital investment projects to reduce methane emissions in the future. These plans—scheduled for completion in late 2010—include capturing low-pressure vented and flared gas at the Heera and Neelam Offshore Platforms in order to compress the gas for sale and internal use and capturing oil storage tank emissions from ONGC's Uran Plant near Mumbai.



Identifying Methane Emission Reduction Opportunities in Russia

Russia is a significant emitter of methane from oil and gas operations because of its large oil and gas operations. As Russian natural gas production continues to grow, identifying opportunities to reduce emissions is increasingly important. Several companies in Russia, including Gazprom, have begun to monitor or mitigate methane emissions from their systems. EPA and Battelle Memorial Institute, an international science and technology enterprise that explores emerging areas of science, have launched a project to work with Russia on methane mitigation in the Russian oil and gas sector. The project focuses on three main areas:

- Exchanging technical information on approaches to reducing methane emissions in the oil and gas sector.
- Developing a network of contacts in Russia to enhance awareness of methane identification and mitigation opportunities in the natural gas sector.
- Promoting technology transfer and investigating opportunities to develop methane mitigation projects in the Russian oil and natural gas sector.

In October 2008, Gazprom, VNIIGAZ (Gazprom's research institute) and EPA, with technical support from Battelle Memorial Institute, held a technology transfer workshop on methane mitigation in the natural gas and oil sectors in Moscow. The workshop focused on exchanging detailed technical information on proven, cost-effective technologies and practices to reduce methane emissions. Participants also visited a Russian compressor station to view several state-of-the-art technologies that detect and measure methane leaks.



Looking Forward

The rationale for engaging in methane mitigation activities has never been stronger: a growing body of research demonstrates how the combined benefits from climate change mitigation and improvements in local air and water quality along with increasing demand for energy are building a market for recovered methane. For the past five years, the Methane to Markets Partnership has supported the development of more than 170 projects, helped dismantle barriers to project development, and promoted projects that complement the United Nations Framework Convention on Climate Change's (UNFCCC's) flexibility mechanisms. Under the Obama administration, the U.S. government is continuing to promote the Partnership's success, urging more robust action on reducing methane emissions and stronger financial commitments to the Partnership, continuing to engage the private sector, and ensuring that Methane to Markets evolves in a manner that is supportive to the UNFCCC. In particular, the United States will focus on several key areas:

- **Renewing the Methane to Markets' Terms of Reference (TOR).** The United States, in its role as Chair of the Methane to Markets Steering Committee, will lead the process of developing a new Methane to Markets' TOR, setting the stage for future growth of the Partnership. The United States is committed to ensuring that the second TOR includes expanded and robust commitments to the Partnership to accelerate the pace of methane emission reduction project development.
- **Organizing the 2010 Partnership Expo.** The United States is pleased to be playing a leadership role in the upcoming Partnership Expo, which will take place on 2–5 March 2010 in New Delhi, India. The first Expo proved to be an effective way to match project development opportunities with relevant skills and resources. In New Delhi and beyond, the U.S. government agencies will aggressively promote partnerships to bring methane recovery opportunities to fruition.
- **Providing Expanded Technical Assistance and Financial Support for Project Development in All Four Methane to Markets Sectors.** The United States will continue its active support for methane reductions in all four sectors of the Partnership. Since the beginning of the Partnership, the United States has provided funding in excess of \$40 million, with \$10.4 million in FY 2008 alone. Several U.S. agencies will continue to conduct training, provide grants, and support pre-feasibility and feasibility studies in all Methane to Markets sectors, including ones that may be added through the TOR renewal process.

The actions of Methane to Markets Partners and Project Network members have resulted in real GHG reductions and elevated awareness among climate policymakers around the world of the importance of methane in the fight against climate change. The U.S. government is proud of the Partnership's collective achievements, which demonstrate that developed and developing countries, along with the private sector, can work together to effectively mitigate climate change in the near term.



Methane to Markets

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To learn more, visit www.methanetomarkets.org



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